Instrument Incubator

Wide-swath Shared Aperture Cloud Radar (WiSCR)

Completed Technology Project (2014 - 2017)

Project Introduction

The Goddard Space Flight Center (GSFC) and Northrop Grumman Electronic Systems (NGES) seek to advance key enabling technologies for next generation multi-frequency space-borne radar for cloud and precipitation measurements. The Earth Science Decadal Survey (DS) Aerosol, Cloud and Ecosystems (ACE) mission calls for a dual-frequency cloud radar (W band 94 GHz and Ka-band 35 GHz) for geospatial measurements of cloud microphysical properties. Meanwhile, a tri-frequency spaceborne radar concept (W band 94 GHz, Ka-band 35 GHz, and Ku-band 14 GHz) is being considered by the cloud and precipitation science communities. We envision a Wide-swath Shared Aperture Cloud Radar (WiSCR) that will provide unprecedented, simultaneous multi-frequency measurements to enhance understanding of the effects of clouds and precipitation and their interaction on Earth climate change. ESTO's Instrument Incubator Program (IIP-2010), enabled our investigation team to success-fully demonstrate the technical feasibility of a shared, large aperture antenna to achieve wide swath imaging at Ka-band and nadir profiling at W-band. Our approach employs a parabolic cy-lindrical reflector with a Ka-band Active Electronically Scanned Array (AESA) line feed to achieve a swath exceeding 120 km. A low-loss reflectarray surface is applied to the primary re-flector to provide a focused W-band beam. We propose to advance these technologies to address the emerging needs for spaceborne atmospheric radar. We will advance the technology readiness of WiSCR through the following activities: (1) de-sign/develop the Ka band AESA module including the GaN power amplifier MMIC, the GaAs multi-function MMIC, the GaAs low noise amplifier MMIC, the Power Controller/Gate Regula-tor ASIC, and the transmit/receive circulator; (2) develop through airborne demonstration a Mul-ti-channel Arbitrary Waveform Generator (MAGW), a Multi-channel Frequency Conversion Module (MFCM) and a novel Frequency Diversity Pulse Pair (FDPP) technique; (3) investigate architectures that extend our dual-band aperture technologies to provide tri-frequency shared ap-erture capability.

Develop and mature WiSCR technologies to enable concurrent multi-frequency measurements of clouds and precipitation - Ka-band Active Electronically Scanned Array (AESA) T/R module package with integral circulator - Frequency Diversity Pulse Pair (FDPP) algorithm to enable spaceborne Doppler measurements of weather targets - Multi-channel Arbitrary Waveform Generator (MAWG) and Multi-Channel Frequency Conversion Modules (MFCM) to enable a versatile waveform that is essential for FDPP and reduce size, weight, power and cost of multi-frequency radar hardware Develop concept design for tri-frequency radar (Ku/Ka/W Band) to assess potential addition of GPM mission capabilities

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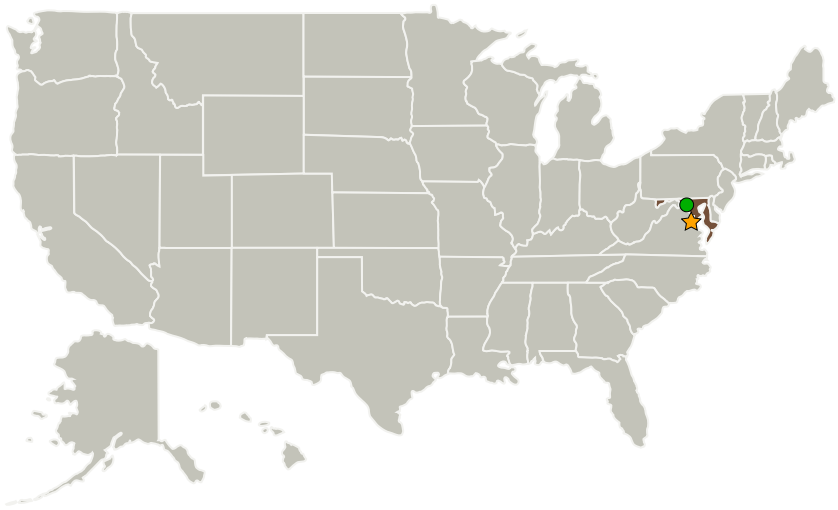
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★NASA Headquarters(HQ)	Lead Organization	NASA Center	Washington, District of Columbia
●Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Lead Center / Facility:

NASA Headquarters (HQ)

Responsible Program:

Instrument Incubator

Project Management

Program Director:

Pamela S Millar

Program Manager:

Parminder S Ghuman

Principal Investigator:

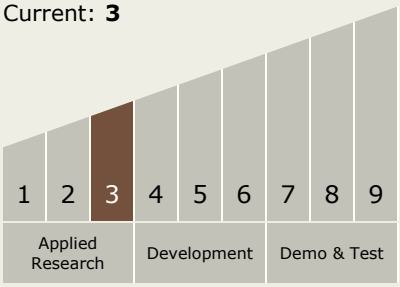
Lihua Li

Co-Investigator:

David T Leisawitz

Technology Maturity (TRL)

Start: **3**
Current: **3**



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Images

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(https://techport.nasa.gov/image/5114)

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.4 Microwave, Millimeter-, and Submillimeter-Waves

Target Destination

Earth